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UNIVERSIDADE DE LISBOA

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MASTER´S FINAL WORK

DISSERTATION

LEADING INDICATORS OF BANKING CRISES IN EUROPE

MARTA GONÇALVES BARROS

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SUPERVISION:

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Resumo

O presente estudo analisa as melhores variáveis para prever uma crise bancária na União Europeia, focando-se especialmente no crescimento do crédito bancário a particulares e empresas. A amostra é constituída por dados anuais de 1960 até 2016 de onze países, todos pertencentes à UE antes da Crise Financeira de 2007-2009. Os modelos *logit* e *OLS linear probability* foram utilizados para avaliar que variáveis influenciam a probabilidade de ocorrência de uma crise bancária e, posteriormente, para analisar as variáveis mais impactantes na evolução do crédito a sociedades não financeiras. Os resultados evidenciam que quando o crédito bancário está a crescer há quatro anos, a probabilidade de ocorrência de uma crise bancária, no ano seguinte, aumenta. Estes resultados assemelham-se ao que foi encontrado por Bordo & Meissner (2012) e Schularick & Taylor (2012), pois também argumentam que o crescimento exponencial do crédito é uma boa variável para estimar uma crise.

Palavras-chave: Crise Financeira Global, União Europeia, crescimento do crédito a particulares e empresas.

Abstract

This study examines the variables that are more appropriated to predict a banking crisis in the European Union, with a special focus on private credit growth. The sample is composed by annual data from 1960 until 2016 from eleven countries, all belonging to the EU prior to the Global Financial Crisis. It is used the logit and the OLS linear probability models to assess what variables influence the likelihood of a banking crisis and, afterwards, to analyze which variables influence the evolution of private credit. The results provide evidence that when credit is growing for four years, the probability of facing a banking crisis, in the following year, increases. This finding is similar to what was found by Bordo & Meissner (2012) and Schularick & Taylor (2012), as they also argue that credit booms are good estimators of financial crisis.

Keywords: Global Financial Crisis, European Union, private credit growth

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Abbreviations and acronyms

CI – Credit Institutions

EBA – European Banking Authority

EIOPA - European Insurance and Occupational Pensions Authority

ESMA - European Securities and Markets Authority

EU – European Union

GDP – Gross Domestic Product

GFC - Global Financial Crisis

IMF – International Monetary fund

OLS- Ordinary Least Squares

US – United States of America

ROC – Receiver Operating Characteristic

VEC model – Vector Error Correction model

WDI - World Development Indicators

1. Introduction

Financial crisis represents a period in which the banking sector of a country is facing systemic bank panics and significant output losses that lead to bankruptcy, forced mergers among financial institutions and government interventions (Schularick & Taylor, 2012). One of the most harmful financial crises in history was the Global Financial Crisis (GFC) of 2007-2009, that unveiled all existing problems of the global financial system. This crisis stimulated a new interest on understanding the impact that credit and money variations could have on macroeconomy and their explanatory role in generating and expanding shocks throughout time (Schularick & Taylor, 2012). The GFC started with the bust of the US housing bubble and quickly spread to the rest of the world. Banking crises are an "equal opportunity to menace" (Reinhart & Rogoff, 2013), as they affect both developed and developing countries, and the GFC was no exception. This banking crisis resulted from a combination of economic and financial elements, related to poor risk management strategies (Restoy, 2017).

In Europe, due to the tight connection between both, the GFC evolved into a sovereign debt crisis, which worsened its economic position. The original design of the Euro is considered one of its causes, since it was not considered its fragility under unexpected environments, making all the EU countries unprepared for these types of events (Lane, 2012). It is also considered as a cause, the unregulated amount of external borrowings that emerged after the elimination of exchange rate risk within the monetary union (Cardão-Pito & Baptista, 2017).

In response to the GFC, worldwide authorities had to create a set of regulatory reforms that would reduce significantly the likelihood of a future financial crisis and moderate its

damaging impact, if one occurs (Restoy, 2017). The Basel Committee on Banking Supervision developed Basel III, which is an extension of Basel II framework, with the aim of strengthening regulation, supervision and risk management of banks. Its standards are minimum requirements that must be implemented by the committee members in a predefined timeframe. Due to the importance of regulation, in the EU was established a new European System of Financial Supervisors (ESFS), composed by three supervisory authorities: European Banking Authority (EBA), European Insurance and Occupational Pensions Authority (EIOPA), European Securities and Markets Authority (ESMA), and the European Systemic Risk Board (ESRM). The ESFS aims to reinforce European supervisory provisions to protect its citizens and to rebuild the creditability of the European financial system (Regulation (EU) No 1092/2010).

Banking crises cannot be fully predicted by a single variable, due to their complexity (Hedin & Johansson, 2017). However, several authors have been able to identify which variables increase, or lessen, the likelihood of a banking crisis. Private credit growth is one of the key variables with a positive relation to banking crises (Schularick & Taylor, 2012; Bordo & Meissner, 2012). If the latter rises, the probability of having a crisis follows the same pattern. The type of credit is also important, and there is evidence that mortgage loans have a higher predicting ability (Jordà et al., 2014; Kirschenmann et al.,2016). This loan type aggregates the total amount of credit secured by real estate, which leads us to believe that the prices of the latter could also influence financial crises. Previous literature confirms this belief, as house prices contribute to the likelihood of crisis (Kemme & Roy (2012); Lainà et al., 2015). Other authors go beyond credit booms and house prices, and study the influence of complementary macro,

financial and external indicators, like GDP, short-term interest rates, terms of trade and current account (Büyükkarabacak & Valev, 2010; Hamdaoui, 2016).

Since the GFC, the literature on financial crises has grown substantially. It has been approached by academics, regulators and specialists in finance and economics, who use different methods and databases to analyze various components that may have contributed to the crisis. Despite of all existing information, this subject requires constant updates, as it relies on the economy, which never stops changing.

Most of the existing literature tends to study samples that include information from a large set of countries throughout a very long-time period. Datasets that focus on a smaller group of countries or on a smaller time frame can detect other weaknesses and vulnerabilities, contributing with new information to this research area.

This paper assesses the predicting abilities of several variables, with a special focus on private credit growth. My panel data includes information on eleven EU countries from 1960 until 2016. Besides credit, it will also be investigated the predicting abilities of 10 additional variables, among house prices, real GDP per capita and current account. This set of variables will be tested twice. Firstly, to examine if they influence the likelihood of a banking crisis and secondly, to analyze if they can explain credit growth.

In my research methodology, I analyze a sample containing 17 episodes of financial crisis in order to test if credit growth can increase the likelihood of a systemic banking crisis. My findings are in accordance with previous literature, as I find that private credit growth over the previous four years is a good indicator.

This paper is organized as follows. The next chapter provides a more detailed literature review on this subject. Chapter three summarizes the main predicting variables found in earlier studies. Chapter four describes the hypothesis under analysis. Chapter five defines the variables and describes the methodologies used to perform the statistical tests. Chapter six presents the analysis' results and finally, chapter seven discloses the conclusions and proposals to future research.

2. Literature review

2.1 Global Financial Crisis

The past decade has been a period of change, new supervision and regulation. The GFC of 2007-2009 was the reason for these developments in the global economy. The impact of the GFC emphasizes the importance of understanding financial crises, to avoid a similar financial turmoil and in the case of a new one, to prepare macroeconomists and policymakers for the chain of events following crises (Jordà et al., 2014).

The aftermath of severe financial crises has three common features. The first one is the profound and long-lasting decrease in the asset market, as house and equity prices decline, on average, 35.5% and 56% over a six-year and a three-and-a-half-year period, respectively. The second is the deep contraction in output and employment, over a downturn span of four and two years, correspondingly. Lastly, the colossal increase in government debt, 86% on average, mainly linked to the crash in tax revenues, which was a foreseeable consequence of the crisis, and to the escalation of government spending to control and fight the recession (Reinhart & Rogoff, 2009).

Financial crises are rare events in developed economies (Jordà et al., 2015; Kirschenmann et al., 2016). Claessens & Kose (2013) discuss the most relevant types of

financial crises and they group them into four categories. Firstly, there are currency crises, which involve a sharp depreciation of the currency due to speculation. Secondly, sudden stop crises, that occur when international capital inflows decrease drastically. The third type is the debt crises, which take place when the government does not honor its debt obligations. And finally, the last type identified corresponds to banking crises, which are triggered by bank runs and, can lead to bank panics being, typically, followed by large output losses (Jonghe, 2010).

These several types of financial crises can interact between themselves. For instance, Laeven & Valencia (2012) argue that banking, currency and debt crises can arise simultaneously, notwithstanding the higher frequency of occurrence of the twin crises associated with currency crises.

Banking crises are the most common type of financial crises due to the fragility of the banking system associated to its intrinsic role, the maturity transformation (Claessens & Kose, 2013). The maturity transformation is the conversion of short-term deposits into long-term loans (Persaud, 2016; Drechsler et al., 2017). When a high number of depositors' savings are withdrawn, i.e when a bank run occurs, it is very likely that the financial intermediary will become insolvent (Claessens & Kose, 2013). Bank panics are not irrational events, they happen when there is information that a recession is coming, and the depositors act according to this insight o1n the market (Gorton, 2012).

Barth et al. (2010) believes that banks were at the center of the GFC leading to the bankruptcy of several commercial and investment banks which, nearly, collapsed the whole banking system. This chain of events is defined as a systemic banking crisis (Lainà et al., 2015). However, it was not only banks that contributed to the financial crisis, one

must consider the role of the new financial channels (Claessens & Kose, 2013). One of the most relevant financial intermediaries were shadow banks (Greenwood & Scharfstein, 2012; McCulley, 2009), which perform credit, liquidity and maturity transformation without needing to access central bank's liquidity and public sector's guarantees (Pozsar, 2010). In his exact words, McCulley (2009) states that "unregulated shadow banks fund themselves with uninsured short-term funding, which may or may not be backstopped by liquidity lines from real banks". He also argues that the "shadow banking system is particularly vulnerable to runs", which resembles typical banks.

The subprime crisis takes its origin in the burst of the real estate bubble in the U.S in 2007 (Candelon et al., 2010; Hein & Truger, 2012; Jordà et al., 2015) and it gained strength with the bankruptcy of Lehman Brothers in September of the following year (Hein & Truger, 2012). This crisis amplified substantially the level of instability of the financial system, due to the excessive mortgage lending (André, 2016). As shown by Jordà et al., (2014), mortgage loans represented about two thirds of all U.S bank lending, at the end of 2007. Besides affecting the U.S. financial system, it also disturbed the financial systems of numerous European countries and others around the world due to the interconnectedness of financial markets (Lane & Milesi-Ferretti, 2010).

However, the banking crisis did not affect all countries equally, Rose & Spiegel (2011) find that the richest countries and the ones who experienced a large rise in the stock market in the pre-crisis period, were the ones who suffered the most. Bulbarelli (2016) reaches another conclusion when analyzing two European countries, Spain and Italy. The author finds that, despite of the several commonalities, the different degree of financialization and deregulation led to the creation of a housing bubble in Spain, which worsened its economic health after the financial turmoil, compared to Italy.

Figure 1 resumes the process of the Global Financial Crisis, what led to it and its consequences in Europe. The following two sub-sections will detail further the aftermath of the GFC and its causes, proposing different points of view on what happened.

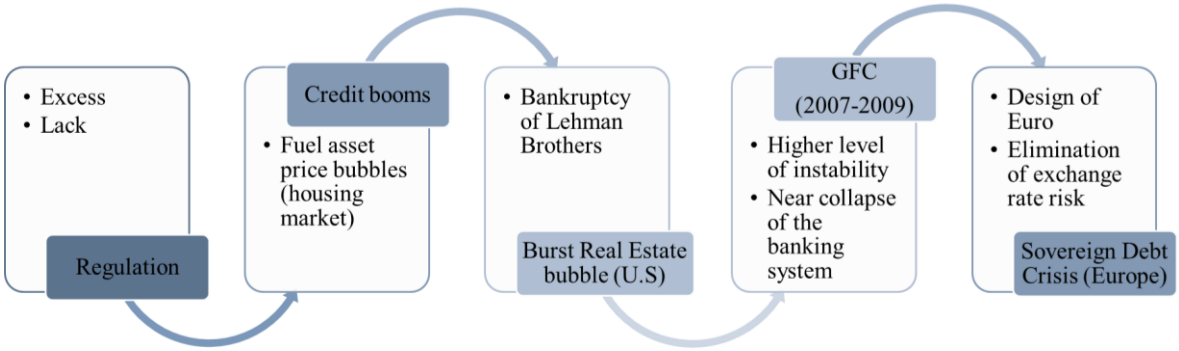

Figure 1- Global Financial Crisis Process

2.2 The aftermath

In Europe, the GFC transformed into a sovereign debt crisis (Reinhart & Rogoff, 2013.a). The GFC recession, aside from weakening their banking systems, uncovered several economic and financial problems, such as the unsustainability of the public finances of some EU countries, making these economies more vulnerable to shocks (Bořuta, 2011).

The increase in unemployment was one of them, and since it impacts public finances, it contributed to high primary deficits and to a sharp rising in sovereign debt, which then evolved into a crisis (Bořuta, 2011). Lane (2012) blames the sovereign debt, its origin and propagation, to the original design of the Euro since it was not considered its fragility under unexpected environments, making all the EU countries not ready for such events. If it had been implemented according to institutions, mechanisms and regulations, several harmful economic incidents could have been avoided (Cardão-Pito & Baptista, 2017).

Cardão-Pito & Baptista (2017) focus on the Portuguese case and they argue that, following the elimination of the exchange rate risk within the Eurozone, the Euro implementation gave Portugal the access to low interest rates and excess liquidity in financial markets, which probably increased credit risk in its economy. These two elements contributed to the capital-flow bonanza and boom-bust cycles, that increased exponentially the level of public and private debt, making the Portuguese banking system very incapacitated when the GFC arrived.

2.3 Causes of the GFC

Financial crises are difficult to characterize since they do not depend only on one variable. Vuković (2011) argues that there has not been a consensus regarding the causes of the global financial crisis, although two opposing views have been defined and their key distinction relies on the reaction to the crisis. The free market approach defends that the lax monetary policy led to the housing bubble and excessive regulation, and the (New) Keynesian blame the GFC on the lack of financial regulation and excessive profit seeking in Wall Street.

Prior to the crisis, several supporters of deregulation believed that financial institutions could regulate themselves through the activities of market participants. Consequently, governments were not willing to adopt new regulation or to analyze the industry, looking for problems that needed to be solved. Excessive regulation was associated to poor financial performance, subsequently the regulatory institutions and their supervisors did not want to restrain financial institutions by creating constrains on credit availability (Financial Crisis Inquiry Commission, 2011).

Free-marketers claim that the banks' risky behavior was instigated by overregulation. Regulators were imposing housing policies, tax cuts and bank capital restrictions which provided the right incentives to banks to enhance their assets with mortgage-backed securities. These government policies led to an excessive level of debt accumulated, which was accompanied by house price inflation, that was already contributing for the growth of the financial sector (Vuković, 2011).

Supporting the (New) Keynesians, Hein & Truger (2012) argue that deregulation and liberalization of international financial markets helped spread the GFC around the world. Besides deregulation, the increasing inequality in income distribution and the growing leverage of the private sector, also contributed to the crisis (Turner, 2014). McDonald & Stokes (2011) point as a cause, the expansive monetary policy practiced by the Federal Reserve, that kept interest rates low promoting reckless borrowings.

However, not all authors agree with these statements. For instance, Dokko et al., (2009) claim that the "relationship between interest rates and housing activities simply is not strong enough to explain the rise in residential investment or house prices."

Returning to the general concept of financial crisis, Claessens & Kose (2013) explain that financial crises tend to be preceded by asset and credit booms that turn into busts, due to the unsustainability associated to these sharp evolutions. Asset price bubbles might be driven by the collective mispricing, associated to expected future returns; and by micro and macro distortions, such as the default of agents that borrow to invest and do not find high enough rates of return. Regarding credit booms, these can be driven by positive shocks in productivity that emerge when GDP is growing; by accommodative monetary policies, as investors and other agents take on more risk; and by drastic

increases in international financial flows, which can be bad if these flows merge the adverse foreign economic conditions into the national panorama. Having the instability scenario created, a small shock in the economic and financial conditions can burst the bubbles and lead to the financial turmoil.

Jordà et al., (2014) demonstrate that credit booms that fuel asset price bubbles, especially the ones associated to the housing market, have a higher likelihood to generate a financial crisis, just like what happened with the GFC.

Acharya & Richardson (2009) support the last authors' arguments by claiming that the financial crisis was caused by the combination of a credit boom with a housing bubble. Their paper evidences other factors that contributed to the crisis, like the loans granted to people that could not repay them and the structured securitized mortgages rated with overwhelming ratings, misleading investors. Despite these contributions, the main cause identified was, in their exact words, "the behavior of many large, complex financial institutions (…) that dominate the financial industry", since these financial institutions chose to absorb all levels of credit risk, making them more vulnerable to market shocks.

According to Acosta-González et al., (2011), the GFC could have been avoided. Their empirical studies demonstrate that the intensity of the crisis seems to be related to financial factors that had suggested the market about the possibility of a financial crisis since 2006. However, these warnings were not taken seriously.

Numerous economists and policymakers ignored the bubble claiming that it did not exist and blamed the run-ups on the housing values and mortgage debts on other factors (Jordà et al., 2015). Fundamentally, they failed to recognize and manage all the risks that could affect the well-being of Americans and, subsequently, of the rest of the

world (Financial Crisis Inquiry Commission, 2011). Reinhart & Rogoff (2013.a) argue that prior to 2008, wealthy economies were assumed to be strong enough to face financial crises, however in a previous study they found that, on average, the number of banking crises and their incidence is "remarkably similar in the high- and middle-to-low-income countries" (Reinhart & Rogoff, 2013), contradicting this belief.

After realizing the massive damage caused by the global financial crisis, policymakers need to pay more attention to signals that may indicate future crises, to improve financial stability (Hedin & Johansson, 2017). Financial crises are very difficult to predict due to their complexity; however previous literature was able to identify warning indictors for the latter (Hedin & Johansson, 2017).

3. Predictors of financial crises

Table I summarizes the analyzed literature exhibiting the direct and indirect explanatory indicators of financial crises found in each paper and the respective data and estimation models to reach such results.

Jordà et al., (2014) analyzes disaggregated bank credit and find that a rapid expansion on mortgage and non-mortgage lending increases the likelihood of financial crises, being the first type the strongest predicting variable. It is also demonstrated that mortgage credit dynamics affect business cycles, and since they are gaining strength among the financial sector, this has become a very important indicator to consider when designing macro-prudential policies. When the growth of mortgage loans reflects an increase on the leverage levels of households, associated to the increase in asset values, highly indebted household portfolios will emerge and may increase the fragility of the

financial system (Jordà et al., 2014). This frailty makes the latter more vulnerable to economic shocks and it creates an environment prone to banking crisis.

Table I - Main Indicators and models used in previous literature

Authors	Main explanatory indicators	Data	Method
Büyükkarabacak & Valev (2010)	Credit, bank debt, GDP, interest rate, M2/reserves	37 developed and developing countries from 1990 to 2007	Logit
Bordo & Meissner (2012)	Credit, GDP and interest rate	14 countries from 1880 to 2008	OLS and Logit
Schularick & Taylor (2012)	Credit	14 developed countries from 1870 to 2008	OLS, Logit and ROC
Kemme & Roy (2012)	House prices	U.S from 1950 to 2005	VEC, Logit and Probit
Jordà et al. (2014)	Mortgage and non-mortgage lending	17 advanced countries from 1870 to 2011	Logit
Lainà et al. (2015)	Loan-to-deposits and house prices	11 EU countries from 1980 to 2013	Logit and Signal extraction
Hamdaoui (2016)	Terms of trade, capital flows, real interest rate, current account and financial exposure	49 countries from 1980 to 2010	Logit and Bayesian Model Averaging
Kirschenmann et al., (2016)	Credit, income inequality and current account	14 developed countries from 1870 to 2008	Logit and ROC

In a previous study[1], it was found that total credit is the best financial crises predictor and that external imbalances increase, to some extent, this predictability. Credit expansions are often related to optimistic expectations regarding future income.

[1] See Jordà et al., (2011)

Büyükkarabacak & Valev (2010) argue that enterprises and households are willing to carry a greater level of debt, when they expect a considerable growth in their income. Hence, if a sharp rise in credit can improve long-term income, borrowers will continue to carry their debt levels. However, if that does not happen, i.e. if the liability levels are higher than the income generated, interest rates will increase, and a deterioration of asset prices or an adverse income shock may increase the probability of a systemic financial crisis (Büyükkarabacak & Valev, 2010). Credit booms can also emerge when the real wages of low-income households decrease, as they will borrow to maintain their level of consumption and their living standards (Bordo & Meissner, 2012).

Schularick & Taylor (2012) contribute to this research area by studying the changes of the financial system and their repercussions on financial stability and monetary policy. Gathering information of 14 developed countries over 140 years, they generated a long run database that was used in subsequent papers to further analyze financial crises' predictors (Jordà et al., 2014; Kirschenmann et al., 2016). Applying the logit and the OLS linear probability models, they find that credit booms are the main predictor of financial crises, including the booms over the preceding five years. However, these booms are not a perfect indicator, as they might be triggered by economic growth and, therefore, are not always related to financial instability (Schularick & Taylor, 2012). They also find evidence that the size of the financial sector impacts the stability of the financial system (the bigger the riskier) and that asset booms, especially stock market booms, are more challenging when they occur in larger financial systems.

Büyükkarabacak & Valev (2010) study the influence of household and enterprise credit on banking crises, analyzing 37 developed and emerging economies from 1990 to 2007. The main difference between these two types of credit is the income generation

produced by firm credit expansions, which counterbalances for the vulnerabilities associated with the rise in debt (Büyükkarabacak & Valev, 2010). They find that credit expansions are accompanied by an increase in the probability of having banking crises and that, from the two types of loans, the growth of credit to business is the strongest predictor.

Regarding other variables included, Büyükkarabacak & Valev (2010) argue that economies with a lower income level, with high ratios of M2 to reserves, high interest rates and extremely large amounts of external bank debt are more susceptible to face a financial crisis. Poorer economies are generally weaker, as they produce less output and consequently, generate less income. As a repercussion, investment and employment will decrease, real wages might follow this market trend and ultimately, households will save and borrow less affecting directly banks' activities. Any shock in these elements, may have severe consequences for the economy as that country does not have enough liquidity to absorb the negative impact of the latter. Financial fragility can also appear during the upswing of a cycle, i.e when GDP is growing, as the loans' risks might become underestimated, leading to a rapid expansion of credit (Kelly et al., 2013). Therefore, the number of non-performing loans may increase, making the banks' balance sheets weaker and more vulnerable to negative shocks.

The M2 to reserves ratio, above presented, divides the total money supply of a country over the total amount of foreign exchange reserves. The latter is composed by the reserves in foreign currency that each country's Central Bank has as a backup fund in the case of a sudden deterioration of the national currency. Therefore, this ratio captures the vulnerability that banks have towards runs linked to currency crises (Büyükkarabacak &

Valev, 2010). And as said earlier, bank runs can be very dangerous as they are followed by large output losses which might lead to a banking crisis.

Bordo & Meissner (2012) focus on the role of income inequality on crises, with the aim of validating previous literature on this matter. Using a database with 14 countries, the authors analyze the predicting ability of credit on banking crises and afterwards, they identify the most significant determinants of credit growth. They find that credit expansions have a positive relation with financial crises and that income inequality has no association to credit growth, unlike GDP and low interest-rates. Interest rates are an interesting variable as it affects directly the debtor's solvency. When it reaches high values, it will weaken the debtor's financial viability and capability to pay debt's interest (Hamdaoui, 2016). Bordo & Meissner (2012) argue that when low interest rates reflect inflationary expectations, credit booms are more likely to occur.

Kirschenmann et al., (2016), using the same dataset as Schularick & Taylor (2012), finds the opposite results as Bordo & Meissner (2012 , as income inequality appears to have a strong statistical significance in predicting crises, even if it is considered independently, i.e. not by its possible impact on credit growth. The difference on the results of these two papers can be explained by the variety of channels that income inequality may affect financial stability (Kirschenmann et al., 2016). Other variables like real bank loans and current account imbalances were also considered to be relevant in explaining crises.

Usually a current account deficit occurs simultaneously with a trade balance deficit, and the latter might increase the probability of a banking crisis as it negatively impacts the borrowers' ability to fulfill their debt obligations, particularly those in the

tradable sector (Hamdaoui, 2016; Büyükkarabacak & Valev, 2010). A trade deficit implies that either the export prices are decreasing, or the import prices are increasing, assuming that all else is equal. Either way, the overall wealthiness will decrease which might affect banks' balance sheets, as the amount of savings will drop and the level of default loans may increase, generating, once again, an unstable environment in the financial system. However, a current account deficit can stem from a rise in imports regarding exports, when a certain country is importing more to increase its productivity and, consequently, to be able to export and become a more compatible country in the market. In this case, a current account deficit is not a negative measure as it is associated to economic development and growth. As so, it is necessary to understand where current account imbalances are coming from, when analyzing its imbalances, because a deficit in this variable does not necessarily means that it will have negative repercussion for the economy.

Lainà et al., (2015) analyzes the behavior of several variables in 11 European Union countries to assess the leading indicators of systemic banking crises and the optimal lead-time. For that matter, it was used two different models, that generated complementary conclusions. It is demonstrated, with the logit model, that loans-to-deposits ratio and real house price growth are the strongest indicators. Inflation and current account imbalances were considered weaker elements, due to the lack of evidence concerning their predicting abilities. With the signal extraction method, Lainà et al., (2015) find that every indicator with a lead time of 3 years is very useful for policymakers, which strengths Kemme & Roy's (2012) findings.

Focusing on the significant variables found by Lainà et al., (2015), loans-to-deposits ratio is a complementary variable to total credit, as it indicates the liquidity of

banks by considering the total level of deposits. When the total amount of deposits is not enough to meet the population's credit needs, banks have to be financed through other sources of capital that are generally riskier than deposits, like investments in the financial market. Additionally, a sharp increase in this ratio may indicate that the banking system is nearly facing bank runs, which increases the probability of a banking crises.

As credit booms, asset price boom can also be driven by expectations. Some historical episodes of financial booms were associated to the expectation that asset prices would increase indefinitely, and consequently more houses were bought which raised even further these assets' price (Kemme & Roy, 2012). As house prices increased and credit was more easily available, borrowers liquidity started to decrease since they could not repay their mortgage loans, increasing the level of non-performing loans and the amount of real estate properties on banks' balance sheet, which lead to an extreme level of instability of the baking system. This snow-ball effect was, and still is, unsustainable and very dangerous if it is not followed by an increase in income, which can tone down its costs.

Kemme & Roy (2012) aim to statistically confirm some of the Shiller's (2005, 2008) observations regarding the increasing house prices and their influence in the financial and economic systems. They find that changes in income, population, building costs and long-term interest rates are not able to explain the exorbitant house price increase in the U.S since 1998, like it was suggested by Shiller (2005). Using the logit and probit models on a dataset containing several advanced economies, they demonstrate that housing booms can forecast financial crises and that it is possible to create an early warning system in four countries, U.S, Spain, Britain and Ireland, since reliable signals for banking crises can be emitted three years beforehand.

Hamdaoui (2016) argues that banking crises occur in the expansion phase of the business cycle as their study demonstrates that terms of trade, capital flows and financial exposure are very good predicting variables. Other indicators like real interest rates, current account and GDP per capita, were also found to be significant. In this paper, two models were used to perform the statistical tests, the logit model and the Bayesian Model Averaging. The author shows that the best predictive model is the multinomial logit model, as most of the banking crises during 1980 and 2010 were missed by the binomial logit model (Hamdaoui, 2016).

4. Research Question

When analyzing financial crises, policymakers and regulators must know what indicators they should focus to get the most complete and accurate results. Throughout the years, literature on this matter has grown and it was able to select key variables that might be fundamental for this investigation. As said earlier, the GFC begun in the U.S and quickly reached Europe due to globalization. However, can the inverse be possible, can a financial crisis start in Europe and spread around the world? The most probable answer is, yes. And in order to avoid such financial catastrophe, this paper aims to find which indicators are more appropriated to predict a financial crisis in the European Union.

Firstly, it will be analyzed the predicting abilities of eleven variables, with the aim of, at least, proving that total credit growth is able to predict a financial crisis in the EU, by increasing its probability of occurrence. The second step focuses on credit by examining if a credit boom over the previous five years enhances the likelihood of a banking crisis. Lastly, complementing the credit growth analysis, it is crucial to understand which variables drive this expansion.

5. Data and Methodology

5.1 Sample

The data of the sample is based on the annual dataset created by Jordà et al., (2017). This dataset is an updated version of the ones constructed by Jordà et al., (2011) and Schularick & Taylor (2012), which are commonly used in the literature (Kirschenmann et al., 2016; Jordà et al., 2014). The house price variable is a contribution from Knoll et al., (2017) and any additional information was downloaded from WDI and IMF databases. From Jordà's et al., (2017) dataset, I filtered the number of countries and the number of years, selecting from 1960 to 2016. Table II summarizes the chosen countries and their respective financial crises during the time-period under analysis.

Table II – Dates of systemic banking crises and entrance in the EU

Country	**Year of entry in EU**	**Financial crisis periods**
Belgium	1958	2008
Denmark	1973	1987, 2008
Finland	1995	1991
France	1958	2008
Germany	1958	2008
Italy	1958	1990, 2008
Netherlands	1958	2008
Portugal	1986	2008
Spain	1986	1977, 2008
Sweden	1995	1991, 2008
United Kingdom	1973	1974, 1991, 2008

Financial crises are defined according to Schularick & Taylor (2012), and represent a period in which the banking sector of a country is facing systemic bank panics and

significant output losses that lead to bankruptcy, forced mergers among financial institutions and government interventions.

The United Kingdom is incorporated despite of the Brexit[2], because on the current date, this country is still belonging to the EU. Regarding the systemic financial crisis dates, they are a contribute from Bordo et al., (2001) and Reinhart & Rogoff (2009.a).

The next step was to harmonize the data to make it comparable across countries. In the long-run dataset, the variables that are not displayed in percentage or in an index, are exhibited in local currency prior to the country's entrance in the EU. For that matter, some indicators, namely mortgage and non-mortgage loans, current account and terms of trade, were adjusted to GDP.

The last phase of this process was to normalize the data and eliminate any existing trends, as is performed by Schularick & Taylor (2012). In that sense, it was computed the first lagged differences[3] in each variable, considering only within-country variation. Current account and terms of trade are an exception to this transformation, as they had too many negative values. Therefore, it was only computed the first difference for these two variables. The final dataset is demonstrated in table III and the predicting variables are explained in the next sub-section.

[2] The Brexit represents the decision that was made on 2016 by the British population, about their country leaving the EU (European Commission, 2016).

[3] This implies computing the LN of each variable for each country in each year and, afterwards, the yearly changes.

Table III - Dataset

Time-period	Countries	Frequency	Financial crises	Predictors
1960-2016	11	Annual	17	11

5.2 Methodology

5.2.1 Variables

Table IV summarizes which of the variables in table I are going to be analyzed and the respective initials. These variables capture different elements of an economy which can produce meaningful analyses.

Starting from the top, financial crisis is the dependent binary variable and its codification follows Schularick & Taylor (2012), by taking the value of 1 if a financial crisis occurs and 0, otherwise. Therefore, this is a discrete variable. The remaining variables are continuous, as they assume any number.

Table IV - Variables description

Variables	Initials
Financial Crisis	CRISIS
Real GDP per capita	RGDP
Public debt-to-GDP	DEBTGDP
Current account-to-GDP	CA
Short-term interest rate	STIR
House price	HOUSEP
Total mortgage loans-to-GDP	MORTLOAN
Total non-mortgage loans-to-GDP	NMORTLOAN
Total credit	CREDIT
M2 to international reserves	M2RESERVES
Terms of trade	TERMSTRADE
Loans-to-deposits	LDEPOSITS

Real GDP per capita is a very interesting predictor as it measures a country's economic performance and, it is included due to the link between financial crises and the inefficiency of the legal systems implemented in destitute economies (Büyükkarabacak & Valev, 2010). Real GDP per capita is Gross Domestic Product based on purchasing-power-parity (PPP) per capita. Public debt-to-GDP is also included in this study despite of being a consequence of crises (Reinhart et al., 2012). However, there is statistical evidence that this variable is negatively correlated to bank credit (Bonis & Stacchini, 2010). This ratio is the total amount of gross government debt as a percentage of its GDP and it demonstrates an economy's strength, being a crucial element for the sustainability of government finance (OECD, 2018). These two predicting variables complement each other because the first one focuses on the overall economy, and the last one emphasis one of the most important participant in the society, the government. The previous two indicators, as well as the following ones, were collected from Jordà's et al., (2017) dataset.

Regarding credit variables, total credit is defined as the ratio between total bank lending and the local consumer price index. In turn, total lending is defined as the end-of-year outstanding amount of domestic currency loans, excluding within the financial sector (Schularick & Taylor, 2012). This indicator is assumed to be divided into mortgage and non-mortgage loans, which will be also tested. Mortgage loans represent the aggregate of loans to households secured with real estate, and non-mortgage loans are the remaining value (Jordà et al., 2014).

The current account records a country's trading activities in the balance of payments covering the payments of income, exports and imports of goods and services and transfers among residents of that country and nonresidents (International Monetary Fund, 2018). A deficit in this measure implies that an economy is producing less than it

consumes, which increases the amount of capital borrowed by this country. These flows may lead to market bubbles and if the level of domestic credit is exploding, then it may origin inflationary pressures (Kirschenmann et al., 2016). Thus, it is expected a negative relationship between this variable and the probability of a banking crisis. To consider the effect of the rates at which short-term borrowings among financial institutions are affected, or the rates at which government paper is issued, short-term interest rates, which are nominal percent per year, are included in this set.

Despite of the information contained in the long-run dataset, the following variables were comprised to consider more, possible, predictors of financial crises. The ratio of loans-to-deposits is one of them (Lainà et al., 2015) and represents how much is the total amount of loans to the private sector secured by deposits. As said earlier, one of the roles of the banking system is to transform maturities, and this ratio demonstrates how well they do it. The latter was retrieved from the International Monetary Fund (2018).

Terms of trade, used as a predictor in previous studies (Hamdaoui, 2016), is also included, and it demonstrates a country's trading efficiency through subtracting the capacity of importing to the capacity of exporting goods and services. It is defined as the percentage ratio of the export unit value indexes to the import unit value indexes, measured relative to the base year (WDI, 2018). The last indicator is M2 to reserves, and it captures the external environments that countries encounter by measuring the broad money (M2) as a percentage of foreign exchange reserves. The total amount of broad money was collected from Jordà's et al., (2017) database, and it is defined as the sum of currency in circulations, overnight deposits, deposits with an agreed maturity of up to two years and deposits redeemable at notice of up to three months (ECB, 2018). The outstanding amount of foreign exchange reserves, which includes a countries' holdings

of foreign currencies and gold, and terms of trade were retrieved from the World Development Indicators database.

5.2.2 Regression Model

The models used to estimate the following equations are the OLS linear probability model and the logit model, as performed by Schularick & Taylor (2012). This last model has been commonly used due to its ability of estimating binary outcomes (Hedin & Johansson, 2017; Jordà et al., 2014; Bordo & Meissner, 2012).

5.2.2.1 Financial Crisis

First, I will test which of the variables present on table IV have the capacity to predict financial crises. I will use a single equation that estimates the probability of a systemic banking crisis, in country i in year t, as a function of all the variables:

$$(1)\quad Pr(CRISIS)_{it} = \varphi_0 + \varphi_1(RGDP_{it-1}) + \varphi_2(DEBTGDP_{it-1}) + \varphi_3(CA_{it-1}) + \varphi_4(STIR_{it-1}) + \varphi_5(HOUSEP_{it-1}) + \varphi_6(MORTLOAN_{it-1}) + \varphi_7(NMORTLOAN_{it-1}) + \varphi_8(CREDIT_{it-1}) + \varphi_9(M2RESERVES_{it-1}) + \varphi_{10}(TERMSTRADE_{it-1}) + \varphi_{11}(LDEPOSITS_{it-1}) + \varepsilon_{it}$$

Where ε_{it} is the error term, which is assumed to be well behaved[4].

The following procedure involves testing for how many years credit must evolve to affect the probability of a banking crisis. Following Bordo & Meissner (2012), the subsequent equation was used:

[4] When a variable is said to be well behaved, this means that it follows a normal distribution. In this case, $\varepsilon_{it} \sim N(0\sim, \sigma^2)$

(2) $$Pr(CRISIS)_{it} = \varphi_0 + \varphi_1(CREDIT_{it-1}) + \varphi_2(CREDIT_{it-2}) + \varphi_3(CREDIT_{it-3}) + \varphi_4(CREDIT_{it-4}) + \varphi_5(CREDIT_{it-5}) + \varepsilon_{it}$$

Where ε_t is the error term, which is assumed to be well behaved. As in Schularick & Taylor (2012), it is considered an annual lag length, P, of 5 as credit booms are considered to last for several years. The models used to estimate equation (1) and (2) are the OLS linear probability model and the logit model.

5.2.2.2 Credit Growth

The next step is to investigate which variables of table III are determinants of credit growth. This study is important because if some variable does not affect directly the probability of a financial crises, it can influence it through credit growth. For that matter, the following regression was used:

(3) $$CREDIT_{it} = \varphi_0 + \varphi_1(RGDP_{it-1}) + \varphi_2(DEBTGDP_{it-1}) + \varphi_3(CA_{it-1}) + \varphi_4(STIR_{it-1}) + \varphi_5(HOUSEP_{it-1}) + \varphi_6(MORTLOAN_{it-1}) + \varphi_7(NMORTLOAN_{it-1}) + \varphi_8(M2RESERVES_{it-1}) + \varphi_9(TERMSTRADE_{it-1}) + \varphi_{10}(LDEPOSITS_{it-1}) + \varepsilon_{it}$$

Where ε_{it} is the error term, which is assumed to be well behaved. As in equation (1), these indicators are lagged by one year.

5.3 Data

5.3.1 Descriptive Statistics

To fit the regression, it was computed the lagged first difference of every variable, except for the current account to GDP and terms of trade variables, in which was only

computed the first difference. Table VIII discloses the descriptive statistics of the variables after this transformation and it can be found in the appendix.

5.3.2 Correlation matrix

To analyze the correlation between the variables, a Pearson correlation matrix was constructed (table IX, in appendix). Overall, the indicators do not show high levels of correlation among themselves, however, there are some special cases. The strongest correlation in this dataset seems to be between house prices and real GDP per capita, demonstrating a linear correlation of 0.910. This implies that these variables are able to jointly explain a certain characteristic or event.

6. Results

6.1 Financial crises

6.1.1 Analyzing all predictors

Table V summarizes the results of equation (1) that studies all the variables' predicting abilities. It is possible to verify that all indicators are jointly statistically significant at the 1% level for the OLS and logit models. The main estimator, credit growth, is statistically significant and has a negative sign, which does not comprise the results found by Bordo & Meissner (2012) and Schularick & Taylor (2012), as they found the opposite relationship between both variables. The statistical result implies that when credit increases from a year to another, the probability of facing a banking crisis, in the following year, decreases. Consequently, this finding demonstrates that yearly credit increases are not as dangerous as before, which might be related to the post-crisis regulation that was imposed all over the world. However, it is still important to follow

credit trends to see if this evolution is alarming, analyzing its causes and possible consequences.

Regarding the credit types analyzed, the annual change in mortgage loans is statistically significant at a 10% level, unlike non-mortgage loans' yearly-evolution. Due to its positive estimator, the probability of a banking crisis is higher when mortgage loans increase, which resembles previous findings (Jordà et al., 2014). This result reminds the importance of analyzing the most important drives of the GFC, as they are still variables that have a considerable impact on the economy.

Table V - Banking crisis: Explanatory variables

	OLS		**LOGIT**	
Variables	B	T	B	Wald
(Constant)	0.069	5.106***	-4.010	38.11**
RGDP	-2.067	-5.683***	-48.273	4.674***
DEBTGDP	0.022	0.282	0.203	0.004
CREDIT	-0.265	-3.258**	-10.223	0.34***
STIR	-0.086	-4.677***	-0.947	3.344
HOUSEP	0.043	0.429	-1.145	0.035
CAGDP	-0.433	-0.824	1.836	0.008
MORTLOAN	0.229	1.844*	8.894	0.699
NMORTLOAN	0.095	0.834	-1.531	0.026
M2RESERVES	-0.060	-2.125**	-1.327	2.037
LDEPOSITS	0.074	0.810	4.317	1.800
TERMSTRADE	0.009	1.928*	0.429	6.33
R^2		0.197	0.126	
Adj.R^2		0.180	-	
Pseudolikelihood		-	79.668	
Test statistics[a]		11.363***	70.204***	

Notes: a - The reported statistic is F for the OLS model and x^2 for the logit model.
* Significance at 10% level
**Significance at 5% level
***Significance at 1% level

Real GDP per capita is statistically significant at 1% level in the OLS and logit models, being negatively related to banking crises. This evidence is consistent with the

findings of Büyükkarabacak & Valev (2010), in which they claim that poorer economies are more likely to face a financial crisis as they might have more difficulties in absorbing the negative impact of an economic shock. Short-term interest rates have significance at the same level as the previous variable, and its coefficient shows a negative sign, implying that an increase in this variable, increases the likelihood of a banking crises. This relation was expected, as people tend to borrow more when credit is cheaper. If these increases last for a considerable period, they may ignite a credit boom which can be very dangerous to the economy.

The M2 to foreign exchange reserves ratio is statistically significant at a 5% level, only in the OLS model, being negatively related to banking crisis. Therefore, there is evidence that a decrease in this ratio is associated to a higher probability of facing a crisis in the following year. As said earlier, this variable is composed by the total amount of money supply of a country and the total amount of foreign exchange reserves. A reduction in the first leads to a decrease in the amount of money that households and firms hold, therefore, they will spend less, save less and have more difficulties in repaying their debt. Regarding the second element, its reduction implies that the economic system is more fragile as it will have less monetary capacity to face negative shocks to the national currency.

Regarding not statistically significant estimators, house prices growth was the variable with the highest expectation of predicting a banking crisis due to its relevance in previous literature (Kemme & Roy 2012; Lainà et al. 2015). This result demonstrates that house prices do not affect, directly, banking crises; however, they can influence it through other variables, like credit. This mismatch of results maybe associated to the usage of different models to analyze the sample or to the sample itself. Loans-to-deposits ratio,

current account-to-GDP and public debt-to-GDP are not statistically significant, indicating that these variables do not have a direct influence on the probability of occurrence a banking crisis. Despite of the statistical insignificance of these variables, the relation between them and the likelihood of a banking crisis can change if these indicators are studied through a longer period, in which it is possible to capture trends that might have interesting information.

6.1.2 Analyzing credit growth

Table VI reports the results of equation (2), which estimates the predicting abilities of credit growth lagged up to five years. The output illustrates that credit growth lagged one year is statistically significant and its estimator has a negative sign, as was reported on table V.

Table VI - Financial crisis: Credit lagged 5 years

	OLS		LOGIT	
Variables	B	T	B	Wald
(Constant)	0.019	1.81*	-4.422	74.179***
CREDIT1	-0.989	-3.296**	-22.786	5.375**
CREDIT2	0.252	0.803	5.033	0.207
CREDIT3	-0.185	-0.585	-7.096	0.363
CREDIT4	0.546	1.832*	17.725	2.468
CREDIT5	-0.185	-1.205	-5.574	0.868
R^2	0.045		0.036	
Adjus. R^2	0.037		-	
Pseudolikelihood	-		132.015	
Test statistics[a]	5.343		21.017	

Notes: a - The reported statistic is F for the OLS model and x^2 for the logit model.
* Significance at 10% level
**Significance at 5% level
***Significance at 1% level

Credit growth lagged 4 years is also statistically significant with a positive coefficient, meaning that it is associated to a higher probability of experiencing a financial crisis. Hence, credit booms that started 4 years prior, are the most significant and,

consequently, the most interesting to study when analyzing the EU banking sector. Unlike former research, there is no evidence that the remaining types of credit growth are statistically significant (Bordo & Meissner, 2012; Schularick & Taylor, 2012). In the OLS model, the sum of the lag coefficients is, approximately, -0.561 and the standard deviation of real loan growth over five years is 0.153. This implies that a continued five-year rise of one standard deviation in this variable is associated to a decrease of 0.086 in the probability of a banking crisis. This finding does not follow the results of Schularick & Taylor (2012), however this difference may be related to the new conscious behavior that the banking sector and its participants have regarding credit growth and its consequences for the economy.

6.2 Credit growth determinants

Table VII summarizes the relation between credit growth and the independent variables from equation (3), which was estimated using the OLS model.

Table VII - Credit growth: Explanatory variables

Variables	B	T
(Constant)	0,011	3,619**
RGDP	0,788	8,602**
DEBTGDP	-0,087	-4,896**
STIR	-0,009	-2,235*
HOUSEP	0,062	2,62**
CAGDP	-0,11	-0,916
MORTLOAN	0,386	13,06**
NMORTLOAN	0,305	12,658**
M2RESERVES	0,007	1,131
LDEPOSITS	-0,009	-0,448
TERMSTRADE	0,004	4,223**
R^2	0,778	
Adjust R^2	0,606	
F-Statistic	78,194**	

*Significance at 5% level
**Significance at 1% level

It is possible to confirm that almost every variable has a statistically significant estimator, which proposes that they can affect credit growth and, consequently, influence the predictability of a banking crisis. There is a strong positive relation between the annual changes of GDP per capita and credit growth, implying that when GDP is growing, the credit levels will also increase. This connection is positive to an economy when GDP growth is followed by an increase in income, investment and output and a decrease in unemployment, which makes any economy more powerful and resourceful.

However, one must consider the negative side of this relationship. During the upswing of a cycle, i.e when GDP is growing, the risk associated to loans becomes underestimated, which may lead to a rapid and unsustainable expansion of credit (Kelly et al., 2013). Consequently, the level non-performing loans may increase, making the banks' balance sheets weaker and more vulnerable to shocks.

Public debt-to-GDP has a negative and statistically significant estimator, implying that as government debt increases, the amount of total lending decreases. This result follows the findings of Bonis & Stacchini (2010) and suggests that public debt rises is not just a consequence of banking crises (Reinhart & Rogoff, 2009), it can also be one of its drivers. A rise in public debt can be beneficial to a country's economy, in the short-term, if the funds collected are used to invest in economic growth. As so, when used correctly, for example, to build and repair roads, improve education, improve the health system, etc; it may improve the population's living standards. Consequently, the need for credit may decrease as households have more income to spend on other goods and services that they could not afford before. However, in the long term, the continuous increase in public debt might make credit institutions more conservative about lending money. As countries get more indebted, their governments often apply austerity measures to reduce their debt

levels, namely after adverse reactions from financial markets. These measures will affect directly the population's living standards making them less wealthy and, therefore, less able to repay their loans. Hence, knowing this snowball-effect in advance, CI will tend to reduce the amount of credit granted, during public debt rises, to mitigate non-performing loans in their portfolio and to react to the usual funding constrains.

The changes in short-term interest rates show a negative and significant coefficient, suggesting that credit growth increases when short-term interest rates decrease, which is consistent with the findings of Bordo & Meissner (2012). Usually, central banks use short-term interest rates to manipulate the inflation rate. When the first one decreases, the amount of credit borrowed will increase and, consequently, there will be more money to spend by consumers. This boosts economic growth and, ultimately, increases inflation.

Regarding the two credit types, as expected, they are both statistically significant at 1% level, being mortgage loans slightly more relevant in explaining the level of credit growth. This relation indicates that an increase in mortgage loans has a higher impact on total credit than an increase in non-mortgage loans, illustrated by the coefficient value of 0.386 of the former, compared to 0.305 of the latter.

House price growth is statistically significant at 1% level and its coefficient implies a positive association with the dependent variable. This result is in line with Kemme & Roy (2012), who find that house prices are a good predictor of banking crises. House price increases can be very dangerous, especially if credit follows this asset price trend, as it will become an unsustainable situation where borrowers will not be able to repay their mortgage loans because income did not follow the evolution of asset prices.

Hence, banks will have more non-performing loans and real estate properties on their balance sheet, which lead to an extreme level of instability of the banking system.

Terms of trade-to-GDP also shows a strong and significant relation with credit growth. This outcome demonstrates that when the trade balance has positive annual changes, i.e when the level of exports is increasing faster than the level of imports, total lending is going to increase. This relation may represent the need for credit that enterprises have when their business is expanding cross-border, which may influence positively economic growth and consequently, reduce the probability of a crisis. Lastly, the current account-to-GDP, the M2 to reserves ratio and the ratio of loans-to-deposits do not have statistical significance in explaining credit growth.

7. Conclusions and future research proposals

7.1 Conclusion

This study analyzes the variables that are more appropriated to predict a banking crisis in the European Union, with a special focus on households and enterprises' credit growth.

The results show that it is possible to predict a financial crisis in the EU and that credit growth is a good indicator. Previous studies (Bordo & Meissner, 2012; Schularick & Taylor, 2012) found that when credit was growing for five years, the probability of facing a banking crisis increased. However, this new dataset does not provide the same conclusion since there is no statistical relationship between crisis events and credit growth for five years.

This may be explained by the fact that when credit is growing for such a long period, measures that aim to control this variable are applied to the banking system,

preventing another financial disaster. Overall, there is statistical evidence that when credit is growing for four years, the likelihood of facing a financial crisis, in the following year, increases. This new finding may be associated to the awareness of regulatory authorities regarding credit growth and its consequences for the economy.

Additionally, it is demonstrated that non-mortgage loans can influence positively both credit growth and banking crisis, being significant at 1% and 5% levels, respectively. Despite of not explaining banking crisis, unlike the findings of Jordà et al. (2014), the growth of mortgage loans is the strongest variable affecting total credit, demonstrating that it is still, necessary to monitor the evolution of these loans, due to their historical relevance and their repercussions to the economy.

Focusing on the variable that represents the price of the collateral of mortgage loans, there is strong evidence that house prices growth positively correlated to total lending, implying that the latter increases as house prices increase. This relationship is very dangerous, as it can turn into an unsustainable situation where borrowers will not be able to repay their loans, which leads to an extreme level of instability of the baking system.

The results also suggest that low-income economies have a higher likelihood of facing a crisis, as poorer economies are have less resources to face any shock on the economy. However, financial fragility can also appear when GDP is growing, as the credit risk may be underestimated, leading to a rapid expansion of credit (Kelly et al., 2013). Regarding the current account, it is also an interesting variable to study when analyzing banking crises, but it is important to understand the reasons behind that evolution and their consequences for the economy.

To my understanding, there are no papers that focus only on the EU countries presented by Jordà et al., (2017) and in the same time horizon as my study. However, this dissertation is comparable to previous literature due to the subject under analysis. Financial crises depend on the economy and the latter is constantly changing, the comparison with prior findings that used an older time period are very interesting to understand how the economy has evolved. The papers that analyze time periods between 1870 and 2008 (Bordo & Meissner, 2012; Schularick & Taylor, 2012; Kirschenmann et al., 2016), do not consider in their data, the post-events of the GFC. This new information contain valuable contributes to the overall predicting abilities of the variables, as it was shown. The main difference between this analysis and previous literature is that it reflects a more conscious and conservative behavior of the banking system towards significant changes in the economy. Suffering from almost two simultaneous crises, the euro-zone has gain knowledge to prevent a future one, however as the world keeps changing, new indicators may appear and influence the probability of having a banking crisis. In this case, it is crucial for Central Banks to follow all the new market trends and testing for their possible repercussions in the economy.

7.2 Future research proposals

Financial crises are very complex events that are influenced by a variety of factors that are constantly changing, so every additional study that contributes with a new time-period and indicators, can offer new insights on the current economy. Hence, the first suggestion to future researches is to include an up-to-date period to always capture these modifications. It would also be interesting to analyze all the 28 countries belonging to the EU, to have a more complete analysis, mirroring the EU reality. In future researches, it could be included more variables that previously explained financial crises. As for

example, income inequality (Bordo & Meissner, 2012; Kirschenmann et al., 2016), stock prices (Kirschenmann et al., 2016; Hatzius et al., 2010), capital flows (Reinhart & Rogoff, 2013; Hamdaoui, 2016), investment (Alessi & Detken, 2011) and consumption (Hedin & Johansson, 2017).

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9. Appendix

Table VIII - Descriptive statistics

Variables	Mean	Median	Std. Deviation	Minimum	Maximum
CRISIS	0.032	0.000	0.177	0.000	1.000
RGDP	0.016	0.021	0.070	-1.099	0.093
DEBTGDP	0.015	0.010	0.124	-1.221	0.713
CREDIT	0.052	0.044	0.289	-2.536	5.999
STIR	-0.074	-0.014	0.458	-2.643	3.138
HOUSEP	0.052	0.059	0.239	-4.089	0.617
CAGDP	0.000	0.000	0.016	-0.101	0.065
MORTLOAN	0.026	0.026	0.080	-1.210	0.269
NMORTLOAN	0.013	0.015	0.077	-0.326	0.629
M2RESERVES	0.011	0.025	0.253	-2.531	1.735
LDEPOSITS	0.010	0.006	0.083	-0.486	0.991
TERMSTRADE	-0.108	0.001	2.387	-39.190	11.202

Table IX - Pearson Correlation Matrix

	CRISIS	RGDP	DEBTGDP	CREDIT	STIR	HOUSEP	CAGDP	MORTLOAN	NMORTLOAN	M2RESERVES	LDEPOSITS	TERMSTRADE
CRISIS	1											
RGDP	-0.152**	1										
	(0.000)											
DEBTGDP	0.155**	0.171**	1									
	(0.000)	(0.000)										
CREDIT	-0.042	-0.847**	-0.438**	1								
	(0.167)	(0.000)	(0.000)									
STIR	-0.322**	-0.109**	-0.261**	0.352**	1							
	(0.000)	(0.006)	(0.000)	(0.000)								
HOUSEP	-0.069	0.910**	0.192**	-0.850**	-0.159**	1						
	(0.058)	(0.000)	(0.000)	(0.000)	(0.000)							
CAGDP	0.086*	-0.245**	0.091*	0.065	-0.117**	-0.248**	1					
	(0.024)	(0.000)	(0.019)	(0.068)	(0.004)	(0.000)						
MORTLOAN	0.053	0.609**	0.157**	-0.580**	-0.233**	0.670**	-0.225**	1				
	(0.114)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
NMORTLOAN	-0.071	-0.177**	-0.219**	0.375**	0.223**	-0.150**	-0.203**	-0.057	1			
	(0.054)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.096)				
M2RESERVES	-0.108**	0.053	-0.094*	-0.012	0.039	0.042	-0.075*	0.056	0.074*	1		
	(0.007)	(0.113)	(0.016)	(0.395)	(0.185)	(0.171)	(0.043)	(0.102)	(0.046)			
LDEPOSITS	-0.010	0.117**	-0.086*	-0.042	0.105**	0.145**	-0.105**	0.187**	0.261**	0.031	1	
	(0.412)	(0.004)	(0.024)	(0.172)	(0.008)	(0.000)	(0.008)	(0.000)	(0.000)	(0.241)		
TERMSTRADE	0.082*	0.045	-0.027	-0.036	-0.094*	0.042	0.107**	0.086*	-0.220**	0.021	-0.020	1
	(0.031)	(0.150)	(0.268)	(0.208)	(0.016)	(0.170)	(0.007)	(0.025)	(0.000)	(0.312)	(0.326)	

Note: **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). The 2-talied significances are in parenthesis.